

1 INVENTION: Method and Apparatus for Forming Glass Coiled Tube
2 INVENTOR: Thomas R. Birchard
3 ASSIGNEE: 910 Road 20
Madison, KS 66860

4 This application claims the benefit of U.S. Provisional Application No.
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6 BACKGROUND OF INVENTION:

7 The present invention relates to the field of making glass
8 coiled tubes. Glass coiled tubes can be used for a variety of
9 purposes. The present invention is particularly suitable for
10 making glass coiled tubes that can be used not only for a variety
11 of purposes, but are themselves unique decorative glass beads, or
12 can be cut and finished to make unique decorative glass beads..
13 Glass coils, particular those for making beads, are generally wound
14 on a mandrel by hand, one at a time. This is a slow process that
15 requires a slow rate of turning of the mandrel, allows for only one
16 bead at a time to be created, and requires a considerable degree of
17 advanced skill to achieve any degree of acceptable uniformity.
18 Consequently the process is slow, tedious and adapted more for only
19 the most skilled of glass artists.

20 Another method used is the drawn method where basically the
21 glass is melted, a bubble is blown, and the bubble is then drawn
22 into an elongated tube at the desired length, which tube is then
23 cut into smaller portions to create beads.

24 Gartner, U.S. Patent No. 2,545,271, discloses a glass coiling
25 apparatus with a cooling mechanism and a complicated arrangement of
26 moving parts, all for the purpose of creating glass helices having
27 separated glass coils. Gartner in fact teaches to separate the
28 glass coils, just the opposite of what the present invention is

1 designed primarily to do, i.e. to create an elongated continuously
2 fused substantially uniform glass coil tube. Gartner is not only
3 complicated, but also creates the tube in an entirely different
4 manner by moving the glass helix along with an independent wheel
5 directly contacting the surface of the glass from the side.

6 Wellech, U.S. Patent No. 2,296,321, likewise discloses a
7 complicated apparatus with numerous moving parts. Like Gartner, it
8 teaches to separate the coils and has an independent wheel to move
9 the helix and at the same time to draw the glass from the molten
10 glass source. Both Gartner and Wellech, although on the face
11 creating glass tubes, do so in an opposite manner from the present
12 invention, with a complicated machine of moving parts.

13
14 The present invention, while requiring some degree of skill to
15 create the desired glass bead, provides an apparatus and method for
16 creating elongated glass coiled tubes at a speed of 700 to 800 rpm
17 in the preferred mode. These glass tubes can, if kept short, be
18 the beads themselves or can be cut into, as the process describes,
19 smaller glass beads. Moreover, it does not require blowing a
20 bubble to do so. It allows for creation of unique designs of glass
21 coiled tubes and beads at a faster pace; further allows for a
22 process that provides operator control over formation of the beads
23 and their appearance, but at a relatively fast pace; it further
24 provides a method and apparatus for creating tubes of glass and/or
25 beads of relative uniformity with the ability to substantially
26 recreate the same design, and to do so at a relatively fast pace.
27 Moreover, although it allows for relative uniformity in the
28 creation of the coils and beads, some slight variation is allowed
which renders the beads and coils uniquely adapted for artistic

1 purposes. It also provides a glass tube, coil, or bead, where it
2 is desired to have the individual glass coils as visible elements
3 of the end product. It is still the further object of the
4 invention to create such an apparatus that is inexpensive to build
5 and to create such a process that is relatively easy to learn and
6 master so as to allow for mass production of substantially hand
7 crafted coils and beads. It is thus the further object of the
8 invention to create a simple process and apparatus that alleviates
9 the need for cooling apparatus and minimizes the need for moving
10 parts. Consequently it will be seen that these objectives are met
11 with the present invention as described herein.

12 Other objects and features of the invention and the manner in
13 which the invention achieves its purpose will be appreciated from
14 the foregoing and the following description and the accompanying
15 drawings which exemplify the invention, it being understood that
16 changes may be made in the specific method and apparatus disclosed
17 herein without departing from the essentials of the invention set
18 forth in the appended claims.

DESCRIPTION OF THE DRAWINGS:

Figure 1 is a perspective view of the apparatus with the glass in place.

Figure 2a is a perspective view of the mandrel portion of the apparatus with the stabilizing bar.

Figure 2b is a perspective view of the hook portion of the apparatus showing hollow portion 60 through which the stabilizing bar extends.

Figure 3 is a perspective view of an alternative view of the invention with the glass.

Figure 4 is a perspective view of the mandrel in the alternative mode of the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

The apparatus in the preferred mode is shown in Figure 1. The shaping mandrel 7 is connected to a variable speed rotating means such as a motor or hand drill for providing rotational force, which motor is secured to the working table. The shaping mandrel 7 is essentially an elongated rigid member having two ends, the first of which is removably connected to the motor 5, and the second end, in the preferred mode, is in the form of a conical shape 25 having endpoint 26 at the opposing end of the first end. This second end is affixed to the stabilizing bar at 26 which itself, in the preferred mode, is a flattened elongated rigid member having a first end at 26, and a second end 28 which end is extended far enough to hold the desired length of cooled glass tube. In the preferred mode the length of the stabilizing bar is approximately 8 to 12 inches although a much longer length is also envisioned. Block 3 is pivotally connected to base member 1 at 27 and has hole 23 through which the shaping mandrel 7 protrudes. In the preferred mode the location of the mandrel along the imaginary longitudinal axis created by the shaping member - stabilizing bar combination is such that the base of the conical section 25 just begins extending out of the front face 22 of the block. By frame of reference, on the imaginary longitudinal axis of the shaping mandrel - stabilizing bar combination, the drive end refers to that end of the shaping mandrel - stabilizing bar nearest the drill, and the opposing end 28 is referred to as the free end. Consequently it will be seen that the glass coil is formed and moves from the drive end towards the free end. The block 3 has a top end 6 and a base end 22 and is tilted such that the top end 6 is closer to the drive

1 end and the base end is closer to the free end. The shaping
2 mandrel, in the preferred mode, controls the block near the lateral
3 drive point 18. The foregoing creates an angle that requires the
4 hole 23 to be elongated so as to be able to freely receive the
5 shaping mandrel - stabilizing bar. It also allows the glass thread
6 19 to be fed from behind (nearer the drive end) the lateral drive
7 point 18. This lateral drive point is the approximate area where
8 the glass thread not only makes contact with the block, but is
9 where the angle and position of the block are such that the block
10 causes a forward lateral movement of the glass and spiral towards
11 the free end as additional glass material is fed to that point. In
12 other words, the lateral drive point acts as the point at which the
13 rotational or feeding directional movement of the thread is
14 transferred to a lateral movement towards the free end. The angle
15 of the block not only provides the lateral drive force for the
16 glass, but also assists in allowing the glass thread to take the
17 shape of the shaping mandrel. For example, it will be seen that
18 other shapes of the shaping mandrel can be utilized, such as a
19 square shape, as opposed to the conical shape described. If the
20 angle of the block is straight up and down with respect to the
21 imaginary axis, thus creating an essentially 90 degree angle, not
22 only is the lateral drive force minimized, the thread of the glass
23 has far less tendency to take the shape of the shaping mandrel. In
24 other words, if the angle of the block is adjusted utilizing
25 adjustment means at 27, such that the top end 6 is closer to the
26 drive end, the glass thread will more closely take the shape of the
27 shaping mandrel.

28 Hook 11 is slidably attached to the stabilizing bar 9 such

1 that it slides in a lateral direction 15. It has at least one wing
2 13 for catching the end of the glass thread to begin the forming of
3 the glass spiral when the stabilizing bar and hook are turned in
4 response to the drill motion. Consequently it will be seen that
5 the shape of the stabilizing bar acts to turn the hook and the two
6 are connected so as to allow the hook to turn with the stabilizing
7 bar yet slidably move thereon.

8 To create the spiral or glass beads, first, the thread is
9 pulled from the molten glass source 17 and drawn around the wing 13
10 with the hook 11 in place adjacent to the block. The motor 5 is
11 engaged to rotate the mandrel in a direction away from the side on
12 which the glass source is located. The motor and speed are
13 adjustable by way of an electrically connected foot pedal so as to
14 allow the hands to remain free to work the glass. In the preferred
15 mode the motor operates at approximately 700 to 800 RPM, however,
16 a variety of speeds are envisioned. While the motor is engaged and
17 turning, the shaping mandrel, the glass source and thread are
18 maintained so as to be behind (towards the drive end), the lateral
19 drive point 18. Rotational movement of the motor continues while
20 the glass remains plastic (in a molten state) until the desired
21 length of coil is achieved or until the glass is no longer plastic
22 as a result of cooling. While the shaping mandrel turns and
23 creates continuous coil after coil, the coil structure is
24 automatically forced laterally towards the free end, and each of
25 the individual adjacent coils adhere to each other while in the
26 plastic state, creating a continuous glass spiral tube. Thus, the
27 shaping mandrel, as the plastic thread wraps around the same, helps
28 to create a desired effect; consequently by changing the shaping

1 mandrel to a square or other shape, different effects and
2 appearances of the spiral can be achieved. To achieve other
3 shapes, the thread can also be shaped by the operator as the
4 operator is feeding the thread. The lateral resistance provided by
5 the friction between the hook and the stabilizing bar can be
6 achieved and adjusted by simply squeezing with pliers the hook to
7 tighten it against the stabilizing bar, so as to provide sufficient
8 resistance, if against the otherwise laterally free movement of the
9 glass coil for the purpose of assuring that successive winds of the
10 coil maintain contact and adherence with each other. This can also
11 be achieved by utilizing an adjustable screw 10 that tightens the
12 hook to the stabilizing rod 3. The amount of resistance, is varied
13 significantly, achieves different effects.

14 Upon the glass cooling, the tubes , if not of the desired
15 length, can then be cut to the desired rough bead length using a
16 diamond saw or other glass cutting device to produce a uniform
17 square end. A cane cutter can also be used. When the diamond saw
18 is used the result is a nice square end. If the cane cutter is
19 used the result is more or less perpendicular break through the
20 coil at the end of the section of tubing.

21 The rough beads are then cold finished by grinding the rough
22 edges with abrasives to shape and polish the bead.

23 If the tubes are cut into lengths with a diamond saw the rough
24 cut beads are washed to remove any debris left from the cutting
25 process. Then they must be dried to remove water before they are
26 placed on the kiln shelf. The kiln shelf has a layer of kiln wash
27 applied to it to keep the glass from sticking when the beads melt
28 at temperature. This kiln wash (basically a high temperature

1 powdered ceramic material) tends to stick to the bottom of the
2 beads if water from the washing step is not removed before the
3 beads are placed on the kiln shelf. It is desirable to remove any
4 debris and water if the beads are to be finished with a torch.
5 Undesirable debris is not present after cutting the tubes with a
6 cane cutter.

7 The process for kiln finishing the beads then continues by the
8 placing of the rough beads on end on the kiln shelf with enough
9 space between them so that they will not contact each other during
10 the melting process. The kiln shelf is placed in the kiln after
11 the rough beads have been placed thereon and the temperature of the
12 kiln is brought to above 1200F to begin melting the glass. As the
13 melting progresses the top of the beads draw in leaving the tube
14 with a smaller inside and outside diameter than bottom which has more
15 resistance to this effect because of contact with the kiln shelf.
16 The beads also slump down because of gravity and the coils melt together
17 leaving them less defined but more resilient.

18 The process of melting is halted by the operator at the
19 desired moment by turning off and venting the kiln and thus
20 lowering the temperature below the melting point of the glass
21 (approx. 1200F). The desired moment being, in the preferred mode,
22 when the hole size is correct for the desired application of the
23 bead.

24 At this point the bead has been formed by melting and the
25 force of gravity into a conical shape. The beads are then cooled
26 sufficiently to be flipped over so they are then standing on what
27 was their top.

28 The process of melting is then repeated. During this final

1 melting step the beads close in at the top producing a relatively
2 uniform shaped cylinder. After the desired shape of the beads has
3 been achieved the operator vents the kiln to quickly lower the
4 temperature in the kiln to a point below 1200F to stop the melting
5 process.

6 It is desirable to bring the temperature down to the annealing
7 temperature (900F) at this point. The beads are then soaked at this
8 annealing temperature for necessary time, depending on the
9 thickness of the glass, to relieve and prevent stress in the
10 finished glass beads.

11 The beads are then allowed to cool at a natural rate with the
12 kiln closed. Typically the kiln is turned off and not opened until
13 it is near room temperature after the annealing process is
14 complete. This prevents any thermal shock to beads when the beads
15 have been cleaned of any kiln wash the process is complete. This is
16 usually a matter of wiping them off.

17 An alternative method of finishing involves using a hand torch
18 to melt and shape the ends of the glass cylinder. The cylinders are
19 gradually heated to the point where they can be worked with a
20 torch. It is important to heat the glass in a uniform manner while
21 bringing the temperature up in order to avoid shattering the glass.
22 Once the glass is sufficiently hot to work, the ends of the
23 cylinders are heated to the point of being molten. They then become
24 smooth and close in around the hollow center. The torch is
25 withdrawn when the desired hole size has been achieved allowing the
26 glass to cool and halt the effect. The cylinder is then flipped
27 and the other end is finished the same way. The beads are then
28 properly annealed to complete the process.

1 The beads need to be placed in an annealing kiln as soon as they
2 are cool enough to be picked up with tweezers without marking them
3 after they have been finished with a torch. This is at a
4 temperature of about 1000F. The beads are then soaked at this
5 annealing temperature for necessary time, depending on the
6 thickness of the glass, to relieve and prevent stress in the
7 finished glass beads.

8 The kiln is cooled as described before after proper annealing.
9 This completes the process.

10 In an alternative mode of the invention, Fig. 3, the mandrel
11 35 has a first end 34 removably attached to rotating drive means 33
12 and has a second end 43. In this mode of the invention, the
13 mandrel has an elongated square shape, although it could be in a
14 triangle or rectangle shape as viewed from the end. This mode of
15 the invention shown in Figure 3 is more suitable for utilizing the
16 square, triangle and rectangle mandrel shapes and less suitable for
17 the cylindrical shaped mandrel shown in Figure 1.

18 More particularly, the square shape mandrel 35 has at its second
19 end at least one (two, 44 and 46 are shown) extension so as to act
20 as a hook, or grabbing means, for the initial thread of glass to
21 begin the operation. Although it is not absolutely necessary, the
22 mandrel 35 is shown hollow throughout, capable of receiving the
23 elongated stabilizing bar 45 which functions similarly to
24 stabilizing bar 9 in Figure 1, however, stabilizing bar 45 is, in
25 the preferred mode, a simple elongated essentially cylindrical rod
26 shape as opposed to the flattened stabilizing bar 9 in Figure 1.
27 The mandrel 35 protrudes through hole 48 in block 37, which like
28 block 6 in Figure 1 is comprised of graphite or other material

1 nonconductive to the glass attaching. Copper and brass also
2 suffice, although graphite provides a better lubricating effect.
3 Graphite also wears more requiring replacement of the graphite
4 block more frequently. Platinum is also envisioned to provide a
5 durable, nonstick surface.

6 The block 37 is placed at an angle or has an angled face 47 so
7 that the face is not at a right angle with respect to the lateral
8 direction of movement 52. This allows the glass thread 49 to be
9 fed from behind the lateral drive point 51 at which point the
10 thread makes primary contact with the block. The molten glass
11 thread conforming to the shape of the angular mandrel creates the
12 pulling, i.e. drawing force, to pull the glass from the source,
13 much as the hook does in the first mode of the invention.
14 Therefore the glass hook Thus the rotational drive means 33 turns
15 the mandrel 35 which in turn causes the accumulated gathering of
16 the glass thread in the coiled form 41. The glass coil is pushed
17 off of the second end of the mandrel on to the stabilizing bar as
18 the glass material continues to be fed into, accumulate and formed
19 at the lateral drive point. The block 37 is held in place on the
20 table or working surface utilizing securing means 39, such as angle
21 iron 39. The hole 48 in the block 37 is large enough for the
22 mandrel to easily rotate within and with a minimum of friction.

23 This alternative version is used simply by first selecting the
24 desired mandrel such as a rectangular, triangular or square shape,
25 sliding it onto the stabilizing bar and securing the first end to
26 the rotating drive means. The glass is then melted and a thread is
27 drawn, the end of which is attached to either of the hook members
28 44 or 46; the rotating drive means is then turned utilizing a foot

1 pedal control means to turn the mandrel so that, in the preferred
2 mode, the glass thread feeds from over the top side of the mandrel
3 while the mandrel rotates away causing a pulling motion on the
4 glass thread 49. Lateral resistance is provided by both the
5 friction between the glass coils and the mandrel and by adjusting
6 the hooks 44 and 46. By spreading these hooks out somewhat,
7 additional resistance is provided. This resistance assures that as
8 the glass thread 49 comes off of the lateral drive point 51, enough
9 of the glass coil remains in place so as to assure a connection
10 with the next incremental piece of glass thread material so as to
11 assure that the individual glass coils are connected to each other.
12 By changing the resistance, additional and unique characteristics
13 can be achieved. The mandrel is continuously rotated until the
14 desired length of coil is achieved or until the glass thread cools.
15 The coils are then finished, or cut into smaller pieces and
16 finished, as set forth above in the first embodiment.

17 While there have been shown and described particular embodiments
18 of the invention, it will be obvious to those skilled in the
19 art that changes and modifications may be made without departing
20 from the invention or its equivalent, and, therefore, it is
21 intended by the appended claims to cover all such changes and
22 modifications as fall within the true spirit and scope of the
23 invention.